A BREEDING PAIR SURVEY OF CANADA GEESE IN NORTHERN QUÉBEC - 2006

Prepared by:

William F. Harvey

Maryland Department of Natural Resources

and

Jean Rodrigue

Canadian Wildlife Service

Québec Region

Status of Canada geese (Branta canadensis) in the Atlantic flyway was traditionally monitored by mid-winter surveys. However, mixing of resident and migrant geese on wintering areas has seriously reduced the value of mid-winter surveys for monitoring individual populations. Therefore, emphasis of population monitoring has shifted to surveys on breeding areas, where population affiliation is more obvious.

During the 1960's, aerial surveys identified the Ungava Peninsula in northern Québec as the primary nesting area for Atlantic flyway Canada geese (Kaczynski and Chamberlain 1968). Malecki and Trost (1990) used a more quantitative approach to estimate the number of breeding pairs throughout the boreal forest and Ungava Peninsula of northern Québec in 1988. Their findings confirmed that the highest densities were located along the coastal areas of Ungava Bay and Hudson Bay. In 1993, an annual survey was initiated in northern Québec using methods developed by Malecki and Trost (1990) (Bordage and Plante 1993). The objective of this survey is to monitor the status of the migrant population by estimating the number of breeding pairs. This report presents the results of the 2006 breeding grounds survey.

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STUDY AREA

The survey was conducted in northern Québec, north of 51º latitude and west of 67º longitude (Figure 1). The survey is stratified based on Malecki and Trost's (1990) modification of northern Québec's ecoregions (Gilbert et al. 1985). The regions have been described by Malecki and Trost (1990) and Bordage and Plante (1993). Regions 1-3 comprise the area known as the Ungava Peninsula (Figure 1). Region 1 is comprised of inland tundra, with much of the surface covered by granitic bedrock. Region 2 consists mainly of flat coastal tundra, characterized by low relief and numerous ponds and lakes. Region 3 is taiga, with stunted black spruce and tamarack in protected valleys. Elevations range from 100 - 400 m in region 1, 0 - 200 m in region 2, and 100-300 m in region 3. The northern tip of the coastal zone from Ivujivik, southeast to about 150 km north of Kangirsuk, was excluded (Figure 1). Exploratory transects flown in 1993 indicated that few geese use this mountainous area.

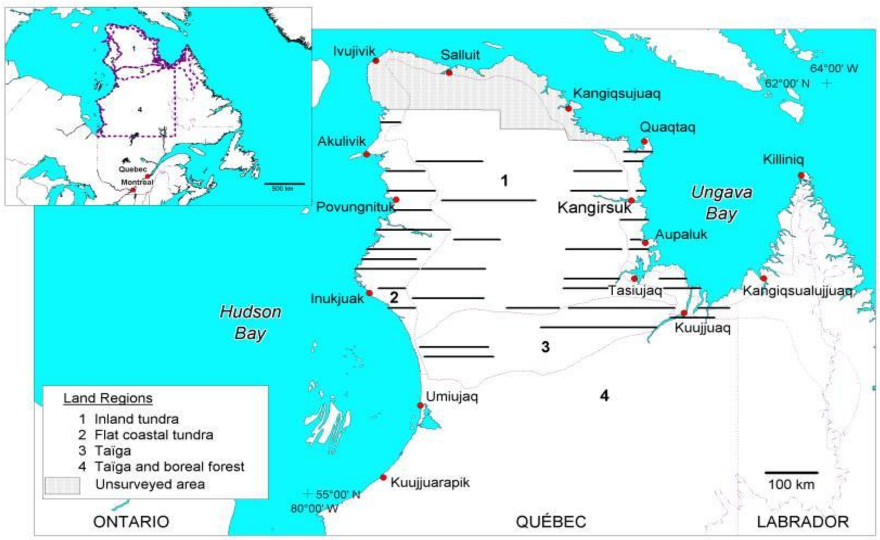

Figure 1. Study area and location of transects for the breeding pair survey in northern Québec.

METHODS

The survey followed the methodology of Malecki and Trost (1990). Aerial transects were flown in a Partenavia twin engine at 30 m above ground level and a ground speed of 140 km/h. The survey is timed to cover the mid to late incubation period. Observers recorded the number of geese observed as singles, pairs, or in groups (3 or more geese) within 200 m of each side of the plane. We occasionally observed multiple pairs of geese in close association (< 10-15 m apart). We classified these geese as grouped birds, since they were unlikely to be associated with a territory. Observers also recorded similar information for other waterfowl species. Coordinates for each location were generated using a global positioning system (GPS) and stored on a lap-top computer. Transects were flown using a GPS to assist with navigation. Transect width was calibrated before the survey began.

Transects were established in 1994 and repeated each year thereafter. Total length of transects sampled in each region was determined using variance estimates from the 1993 survey and a target of 10% coefficient of variation (Bordage and Plante 1994). Transects were randomly located within regions until the desired length was reached. All transects were orientated along east-west lines (Figure 1).

The number of indicated breeding pairs on a given transect was the sum of the singles and pairs observed by both observers. Density of breeding pairs within regions was estimated using quotient estimators while the total population density was estimated using a separate stratified quotient estimator (Cochran 1977). Variances were estimated using the jack-knife procedure (Cochran 1977). The significance of differences in population size between years was assessed with a z-test, using the sum of the sampling variances for the 2 years being compared. The estimates presented in this report are not adjusted for visibility bias and thus represent an index to the population.

Survey Modification in 2006

We began flying transects on June 13. Completion of the survey typically takes about 9 days (range = 6-14 days). The peak of hatching was estimated to be June 20. Thus, it was clear before the survey began that completing all transects before the peak of hatching was unlikely. We decided to complete all coastal transects (Region 2) and drop about 50% of the survey segments in Regions 1 and 3. Our selection process was not random. We included transects based on the following criteria: 1) the transect could be surveyed efficiently with respect to flight time, 2) approximately equal numbers of transects associated with the Hudson and Ungava sides of Regions 1 and 3 were included, and 3) the selected transects would produce an estimated density of breeding pairs similar to the density with all transects included. For example, there are 4 transects in Region 3, 2 in a low density area along Hudson Bay and 2 in a higher density area associated with Ungava Bay. We chose to include

1 transect from the low density Hudson Bay pair and 1 from the higher density Ungava Bay pair. We assessed the likely overall effect of our decision by recalculating the pair estimates for 2001-2005 using only transects flown in 2006 and comparing to the actual pair estimate (Table 2).

RESULTS

Habitat Conditions and Spring Phenology

Transects were surveyed June 13-18. These dates are similar to surveys conducted during 1993-2005, but later than the 1988 survey (Table 1). Early spring temperatures in 2006 were mild and breeding areas were largely snow-free by early May. Large numbers of geese arrived May 8-12 along the Ungava coast and nesting began soon after (P. May, personal communication). We observed 2 pairs with broods during the survey (1 brood on June 17 and 1 brood on June 18), both on the Ungava coast.

At the time of the survey, inland areas had only scattered snow patches and only large lakes remained ice covered. Lakes and ponds in the coastal region were ice-free with the exception of large lakes north of Kangirsuk on the Ungava Bay coast. However, emergence of tree leaves and grasses had just begun to occur on the Hudson coast. In contrast, growth of vegetation along the Ungava coast was advanced; tree leaves were fully emerged and grasses were green. Water levels were low throughout the survey area, reflecting the early snowmelt and lack of rain during May – mid June.

Table 1. Dates of Canada goose pair surveys conducted in northern Québec in 1988 and 1993-2006.

Year	Survey Date	Peak Hatch Date - Hudson Bay	Peak Hatch Date - Ungava Bay
1988	23 May - 3 June		
1993	11-21 June		
1994	21 June - 1 July		
1995	18-24 June		

1996	17-25 June	7 July	2 July
1997	21-26 June	29 June	23 June
1998	20-27 June	20 June	22 June
1999	12-17 June	24 June	26 June
2000	14-27 June	30 June	30 June
2001	11-23 June	22 June	19 June
2002	16-27 June	10 July	3 July
2003	13-21 June	30 June	30 June
2004	19-26 June	July 5	July 5
2005	15-24 June	June 26	June 24
2006	13-18 June		June 20

Survey Coverage

Recalculated breeding pair estimates using only transects flown in 2006 were similar to the actual estimates for 2001-2005 (Table 2). The average difference between the recalculated and actual estimates was 2.4%

Table 2. Breeding pair estimates from 2001-2005 compared to the pair estimate recalculated using only transects flown in 2006.

Year	Actual Pair Estimate With All Transects Included (SE)	Pair Estimate Including Only Transects Flown in 2006 (SE)	Difference Between Actual Pair Estimate and Estimate Using Only Transects Flown in 2006 (% of Actual Pair Estimate)
2001	146662 (18185)	145772 (19642)	-890 (0.6%)
2002	164840 (15169)	159021 (15471)	-5819 (3.5%)
2003	156937 (12273)	161497 (15049)	+4560 (2.9%)
2004	174793 (15049)	181711 (19194)	+6918 (3.9%)
2005	162395 (12622)	160808 (16633)	-1587 (0.9%)

Breeding Total

Pair and Population

Estimates

The estimated number of breeding pairs on the Ungava Peninsula (regions 1,2, and 3) in 2006 (160,020 pairs) was similar to the 2005 estimate of 162,395 pairs (P = 0.912) (Table 3, Figure 2). The total population estimate ((indicated pairs x 2) + non-breeders) in 2006 (1,135,493 individuals, SE = 121,282) was similar to the 2005 estimate of 1,140,755 individuals (SE = 90,609) (P = 0.968). (Note: see discussion for interpretation of total population estimates).

Table 3. Number of Canada goose breeding pairs estimated for the Ungava Peninsula (regions 1,2 and 3) of northern Québec.

Year	Total Area (km^2)	Surveyed Area (km^2)	N Transects	Pairs /km^2 (SE)	Total Pairs (SE)
1988	222700	575	16	0.53 (0.068)	118031 (15144)
1993	222700	838	35	0.41 (0.056)	91307 (12471)
1994	222700	1214	36	0.18 (0.020)	40086 (4454)
1995	222700	1211	36	0.13 (0.013)	29302 (2967)
1996	222700	1211	36	0.21 (0.023)	46058 (5052)
1997	222700	1239	36	0.28 (0.028)	63216 (6201)
1998	222700	1214	36	0.19 (0.023)	42166 (5009)
1999	222700	1208	35	0.35 (0.040)	77451 (8792)
2000	222700	1107	34	0.42 (0.044)	93230 (9850)
2001	222700	1029	31	0.66 (0.073)	146662 (16185)
2002	222700	1214	36	0.74 (0.068)	164840 (15169)
2003	222700	1208	36	0.71 (0.055)	156937 (12273)
2004	222700	1181	35	0.79 (0.068)	174793 (15049)
2005	222700	1214	36	0.73 (0.057)	162395 (12622)
2006	222700	838	28	0.72 (0.074)	160020 (16419)

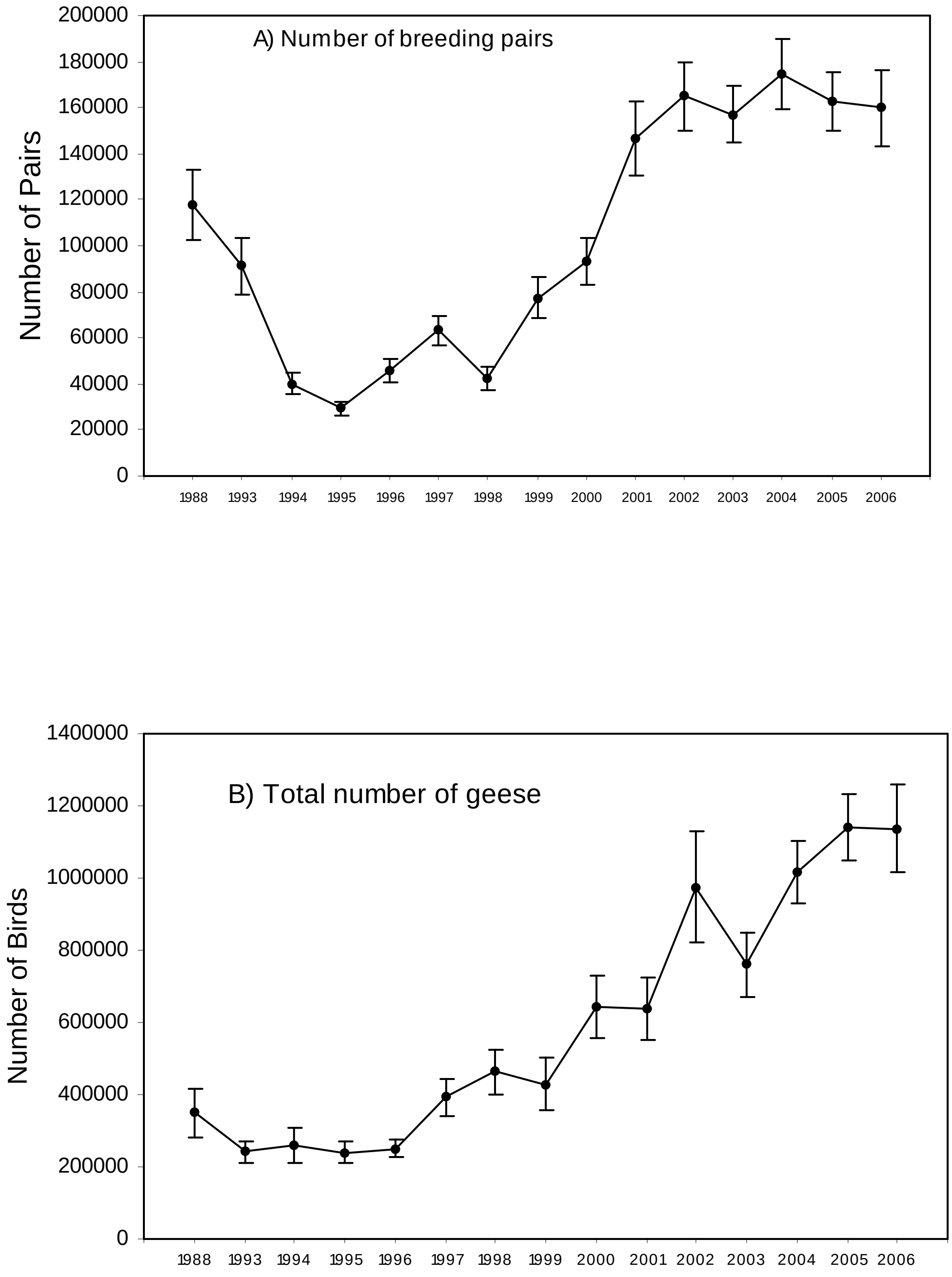

Figure 2. Estimated number (± 1 SE) of Canada goose breeding pairs (A) and total geese (B) on the Ungava Peninsula.

Composition of Indicated Pairs

The number of indicated pairs includes birds recorded as pairs and singles. Single birds are likely to be males associated with an incubating female while pairs include some nesting birds as well as subadult or failed breeders. Therefore, the proportion of indicated pairs observed as singles may provide a more reliable indicator of the proportion of indicated pairs that are actually nesting (see Humburg et al. 1998). The percentage of indicated pairs observed as singles on the Ungava Peninsula was 62% in 2006. This was the highest value observed in the 14 years of the survey (range = 34-62%, mean = 51%).

Comparison of Hudson and Ungava Bay Coasts

From 1993-2000, the estimated density of breeding pairs was similar in the Hudson and Ungava Bay coastal zones, although density along Hudson Bay tended to be slightly higher (Figure 3). Since 2001, the pair density along Hudson Bay has exceeded the density along Ungava Bay (Figure 3). In 2006, density along Hudson Bay (2.77 pairs/km2, SE = 0.405) was greater than along Ungava Bay (0.80 pairs/km2, SE = 0.151) ($P < 0.001$). The estimated density of breeding pairs increased 24% along the Hudson Bay coast and decreased 30% on the Ungava Bay coast compared to 2005 (Figure 3). The estimated density of total geese decreased 13% on the Hudson Bay coast (2006: 16.1 geese/km2; 2005: 18.6 geese/km2) and increased 35% along Ungava Bay (2006: 5.8 geese/km2; 2005: 4.3 geese/km2) compared to 2005. The percentage of indicated pairs observed as singles was higher in the coastal zone along Hudson Bay (65%) than the Ungava coast (51%) in 2006 (Figure 4). The percentage of indicated pairs observed as singles on the Ungava coast is probably biased low because some nests were hatching at the time of the survey.

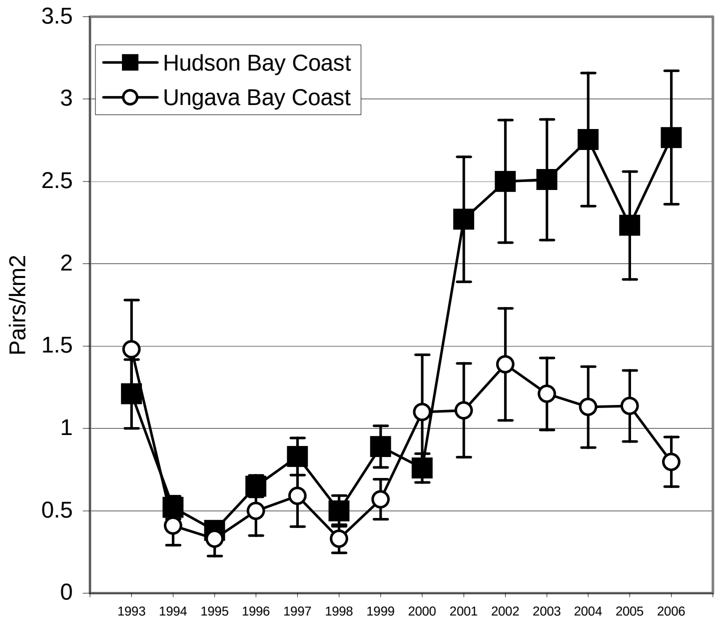

Figure 3. Average density (± 1 SE) of breeding Canada goose pairs for the coastal zones along Hudson Bay and Ungava Bay.

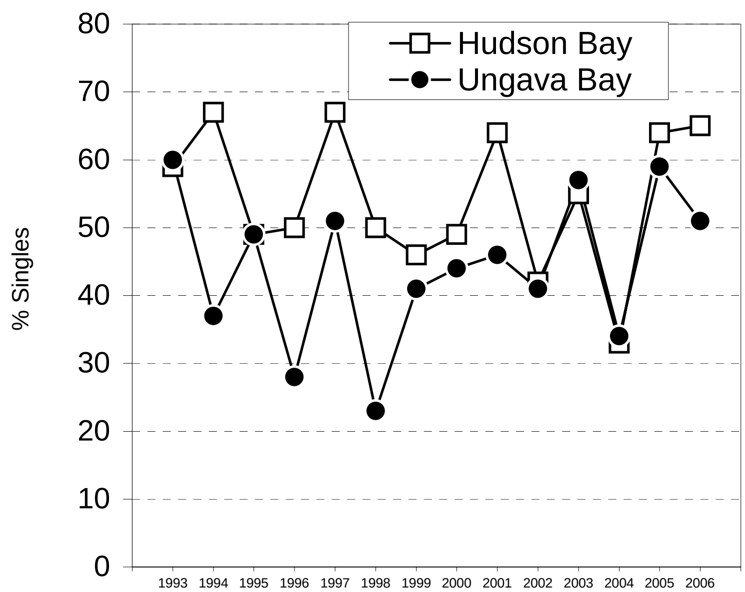

Figure 4. Percent of indicated Canada goose pairs (i.e., singles and pairs) that were observed as singles in the coastal zones along Ungava Bay and Hudson Bay.

DISCUSSION

Survey Coverage

An early spring combined with the delayed departure of the survey aircraft made completion of all transects impossible prior to the peak of the hatch. Our experience has shown that continuing to survey after broods are observed in numbers will lead to a survey biased low because of reduced visibility of pairs with broods. We generally stop the survey after broods are observed on several transects. Rather than leave large portions of the study area unsurveyed, we chose to complete all coastal transects (Region 2) and drop about 50% of the survey segments in Regions 1 and 3, where breeding pair densities are lower and less variable. Prior to beginning the survey, we used the 2005 survey data to select transects that would maintain coverage of the survey area while producing an estimated density of breeding pairs similar to the density calculated with all transects. We made a similar comparison with data from 2001-2004 (Table 2). Based on these comparisons, we conclude that the 2006 breeding pair estimate is probably close (within about 4%) to what the estimate would have been had all transects been completed and is comparable with previous years.

Population Estimates

The estimated number of Canada goose pairs on the Ungava Peninsula in 2006 was unchanged from 2005 and represents the fifth consecutive year of stable breeding pair estimates. The percent of indicated pairs observed as singles was the highest recorded in the 14 years this survey has been conducted. This finding is consistent with the early nest initiation dates observed during nest searches of Ungava Bay study plots (R. Cotter, pers. comm.).

The total population estimate for 2006 was unchanged from 2005 (Figure 2). While the breeding pair and total population estimates have both increased nearly 5-fold since 1995, caution should be used when interpreting the estimate of total population size. Total population estimates include breeding pairs, non-breeders (i.e., those not of breeding age), failed breeders, and molt migrants from other areas. Flocks of geese moving north (likely molt migrants) are often observed along the Hudson Bay coast, especially when winds are from the south. For example, between 0920-1030 hrs on June 17 in 2003 we observed 22 flocks of 2-34 geese moving north past the hotel in Povungnituk. We observed numerous flocks in 2006. Differences in survey timing and the abundance of molt migrants can clearly introduce substantial variability in the total population estimates.

Hudson Bay and Ungava Bay Coasts

The coastal habitat bordering Hudson Bay and Ungava Bay is well known for its high density of breeding Canada geese (Malecki and Trost 1990). However, the Hudson Bay coast supports a much larger breeding population than the Ungava Bay coast. The smaller breeding population along the Ungava Bay coast is partly a function of less land area (Ungava Bay: 9,700 km^2; Hudson Bay: 33,800 km^2) and until recently, a slightly lower density of breeding pairs in most years. The difference in density of breeding pairs has become much more obvious since 2001 (Figure 3); the Hudson Bay coast now supports more than three times the density of breeding pairs than are found on the Ungava Bay coast. This could be related to a number of factors including differential survival or productivity. Productivity surveys have measured lower nest success for geese along the Ungava coast (1996-2005 mean = 52%) than along Hudson Bay (1996-2005 mean = 76%) (Cotter 2006). Similarly, we often observe a lower percentage of single geese along Ungava Bay than Hudson Bay (Figure 4), perhaps indicative of the loss of nests. Whatever the cause, it is increasingly clear that at least in recent years the potential for growth is more limited for geese nesting along the Ungava Bay coast. An analysis of banding data to differentiate harvest rates between geese from Ungava and Hudson Bay coastal areas should be conducted.

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